

Deep Space Cryogenic Power Electronics, Phase I

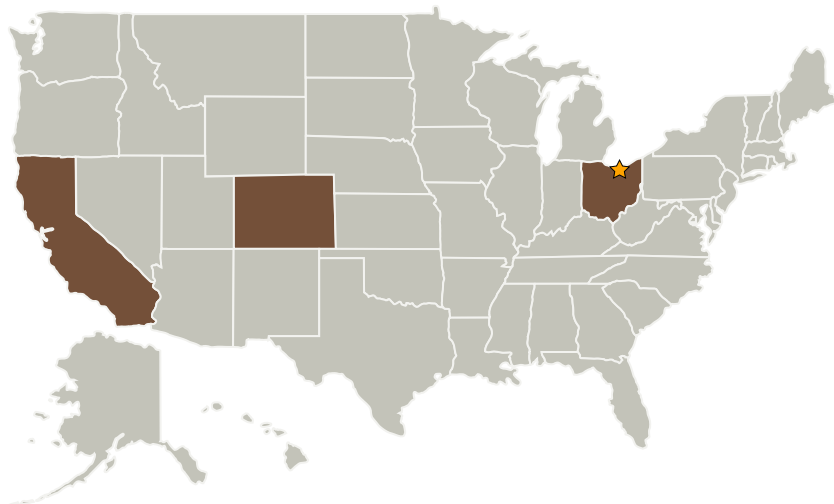
Completed Technology Project (2005 - 2005)



Project Introduction

Technology Application, Inc. (TAI) is proposing to demonstrate feasibility of implementing silicon germanium (SiGe) strained-gate technology in the power complementary metal oxide semiconductor field effect transistor (CMOSFET) and logic devices for a logic and power transistor controller for space-approved stepper motors at cryogenic temperature. Power electronic systems contain digital and analog circuits, and the increasing complexity of these systems required for deep space missions and naval electric-powered propulsion requires a new approach in material and processes to operate efficiently at cryogenic temperature. The metal oxide semiconductor field effect transistor (MOSFET) is the building block for both digital and analog circuits. Silicon (Si) is a good material for fabricating power MOSFET and electronic devices for operation from 300 K to 77 K. Devices made from Si suffer from carrier freeze-out below 77 K. Silicon carbide (SiC) is another material suitable for power switch transistors; however, SiC devices suffer from carrier freeze-out at temperature higher than that of Si. SiGe heterostructure bipolar transistor (HBT) devices are good candidates for low temperature operation. However, SiGe HBT devices suffer changes in characteristics as the operating temperature gets colder. SiGe HBT device switching waveform of a dc-dc converter became distorted below 120 K.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★ Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Technology Applications, Inc.	Supporting Organization	Industry	Boulder, Colorado

Primary U.S. Work Locations	
California	Colorado
Ohio	

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigators:

Thomas E Carroll

Ben Nguyenphu

Technology Areas

Primary:

- TX14 Thermal Management Systems
 - └ TX14.1 Cryogenic Systems
 - └ TX14.1.3 Thermal Conditioning for Sensors, Instruments, and High Efficiency Electric Motors